



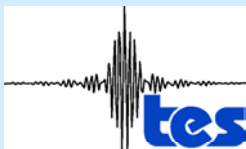
Validation of TES tropospheric Ozone Profiles Using Airborne LIDAR Observations

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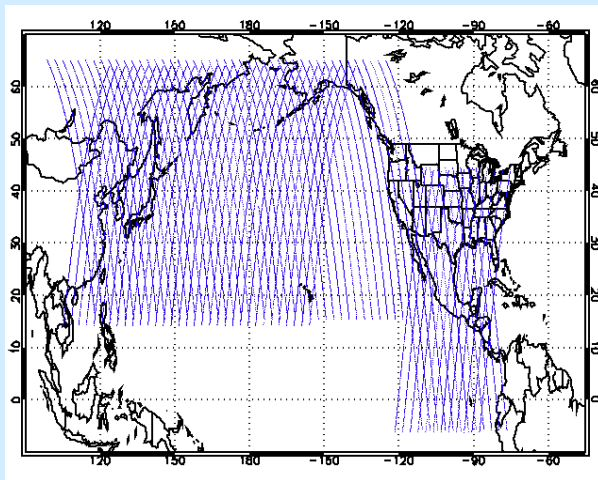
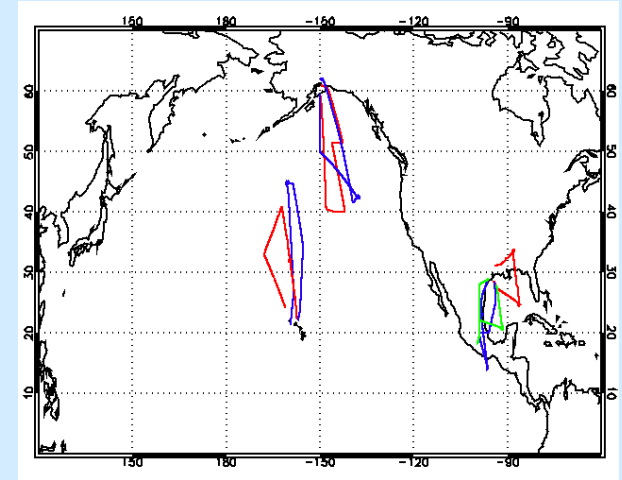
September 2006



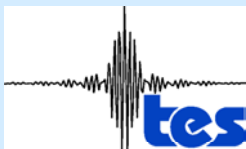


The INTEX-B Campaign

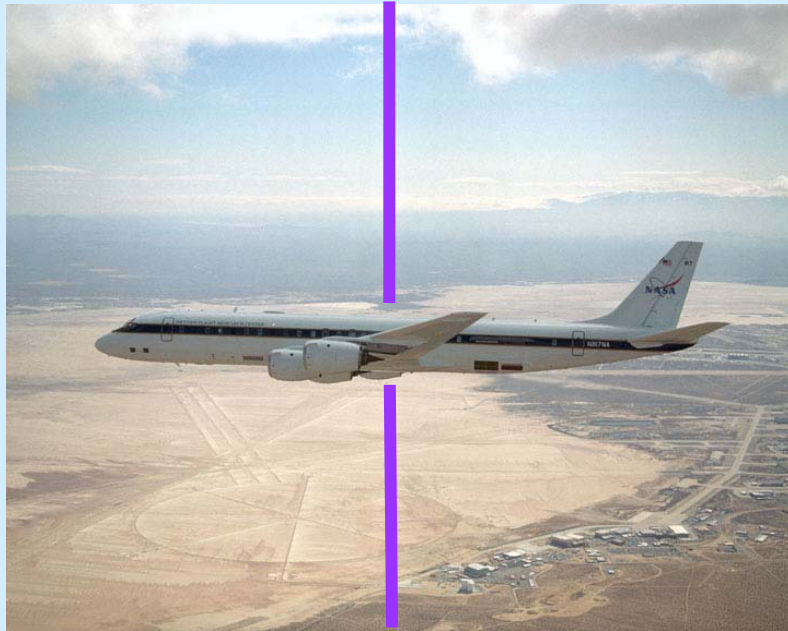
- INTEX-B took place in March-May 2006.
- Measurements were made using NASA's DC-8 aircraft.
- Three geographic regions were sampled (Texas, Hawaii and Alaska).



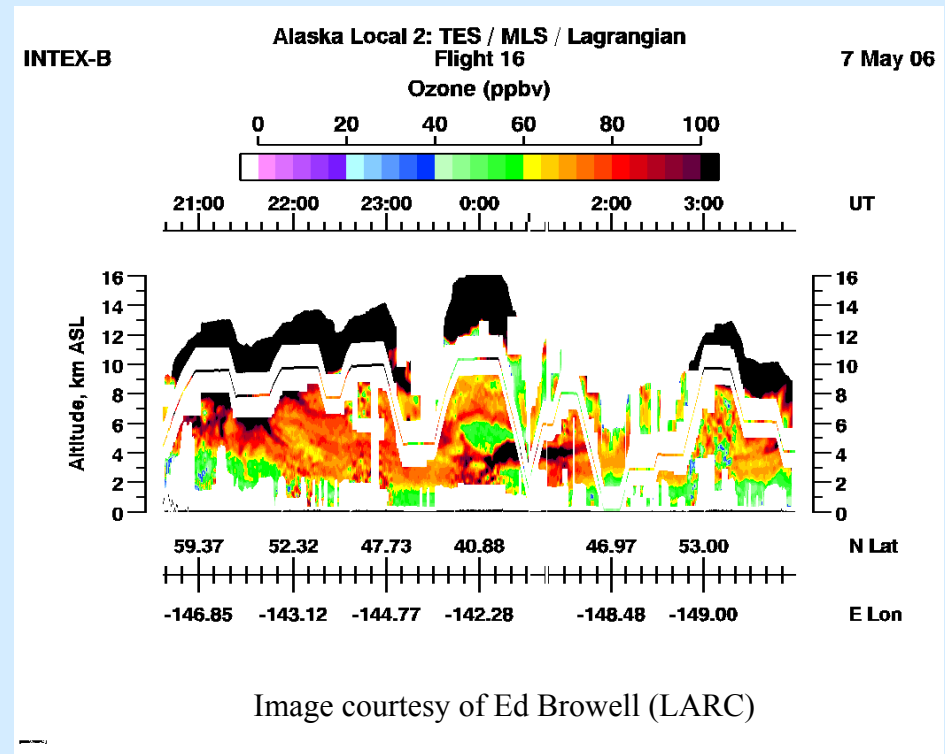
- During INTEX-B TES made 243 Step & Stare special observations.
- 7 DC-8 flights were coincident or near-coincident with TES nadir observations providing ~160 profiles for validation.



DIAL Ozone Profile Measurements



- DIAL makes simultaneous measurements above and below DC-8 of Ozone and Aerosols



- DIAL has an absolute accuracy of better than 10% (2 ppbv).
- Vertical resolution of 300 m.

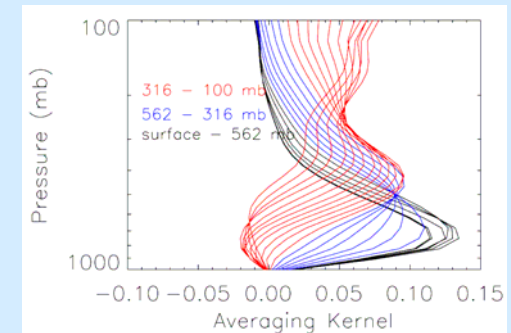


Comparison with TES

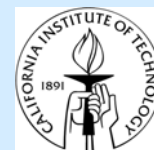
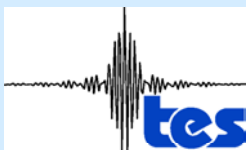
- In order to compare profiles obtained from a remote sensing instrument such as TES with model or *in-situ* data, we must first apply the averaging kernels.
- Averaging kernels intrinsically account for both, and may be used to transform model/*in-situ* profiles into “TES space” so that they may be directly compared

$$\mathbf{x}_{\text{final}} \equiv \mathbf{x}_a + \mathbf{A}(\mathbf{x}_{\text{DIAL}} - \mathbf{x}_a)$$

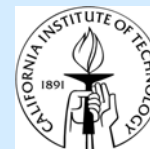
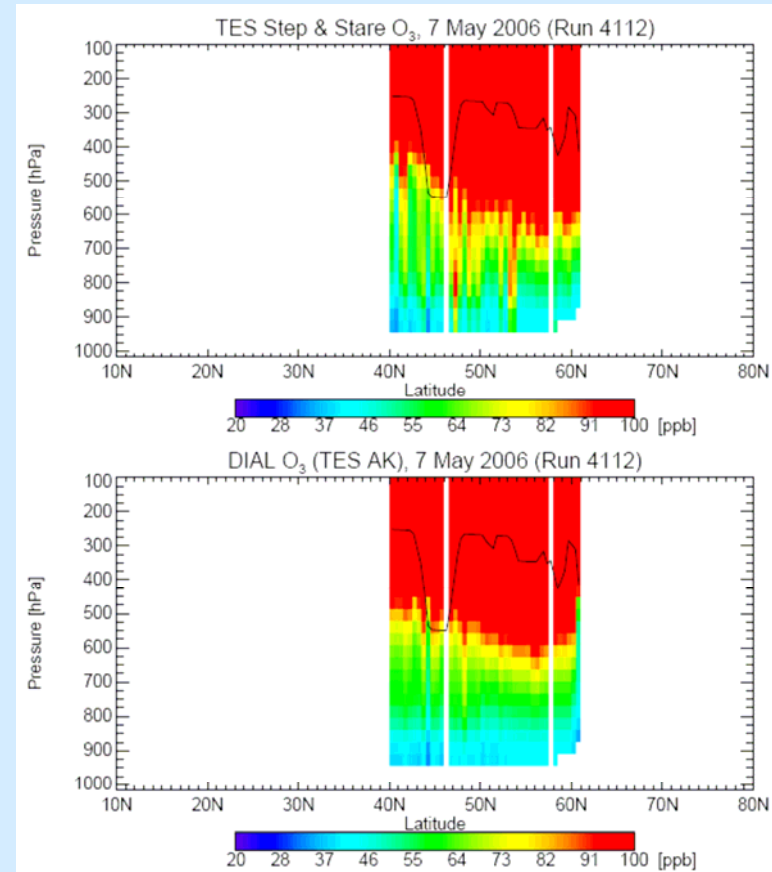
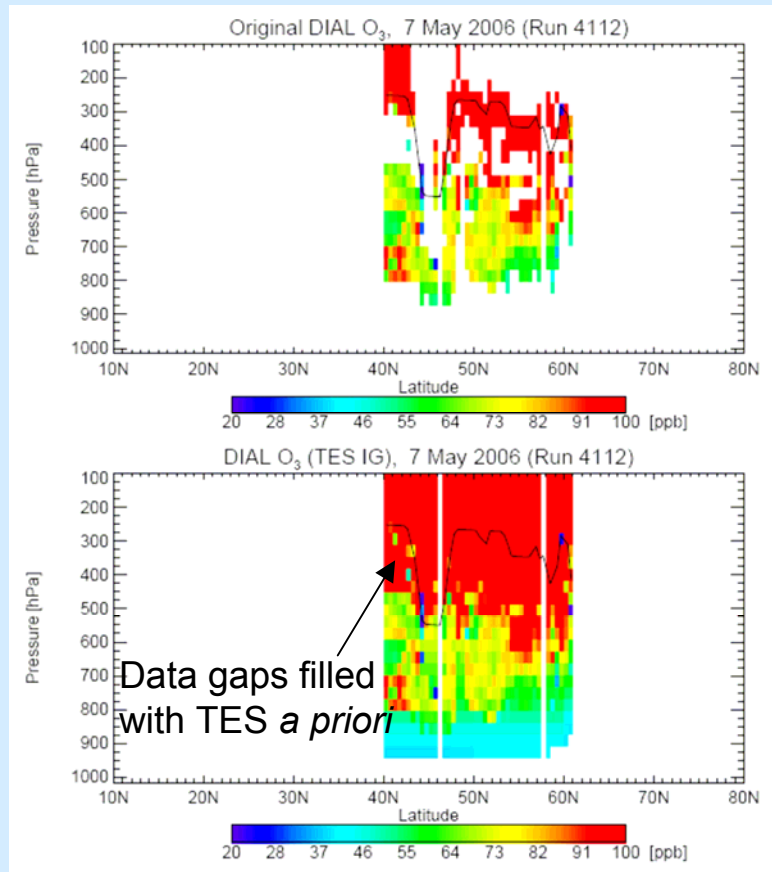
DIAL profile
Averaging kernel
a priori profile



- All DIAL observations within 0.15 degrees lat/lon of each TES observation were selected and averaged for comparison with the corresponding TES profile.
- DIAL profiles were interpolated to the TES pressure grid.
- In order to apply TES averaging kernels to the DIAL profiles missing data in the DIAL profile were replaced with TES *a priori* information, each profile was also extended to the highest TES pressure level using the *a priori*.

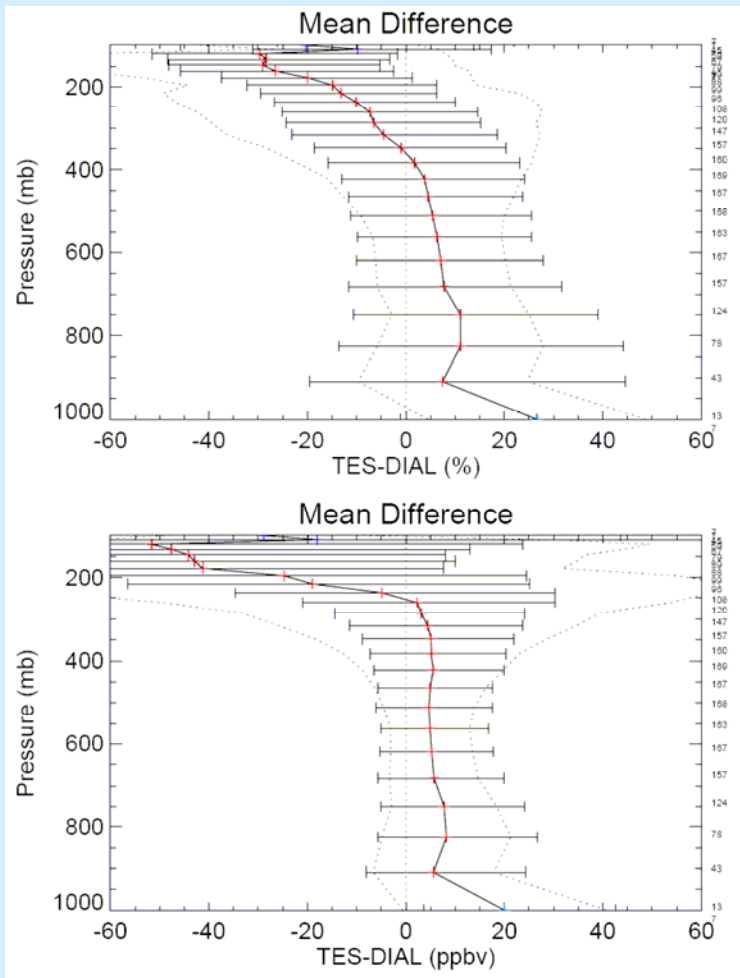


Comparison with TES



Results

All profiles



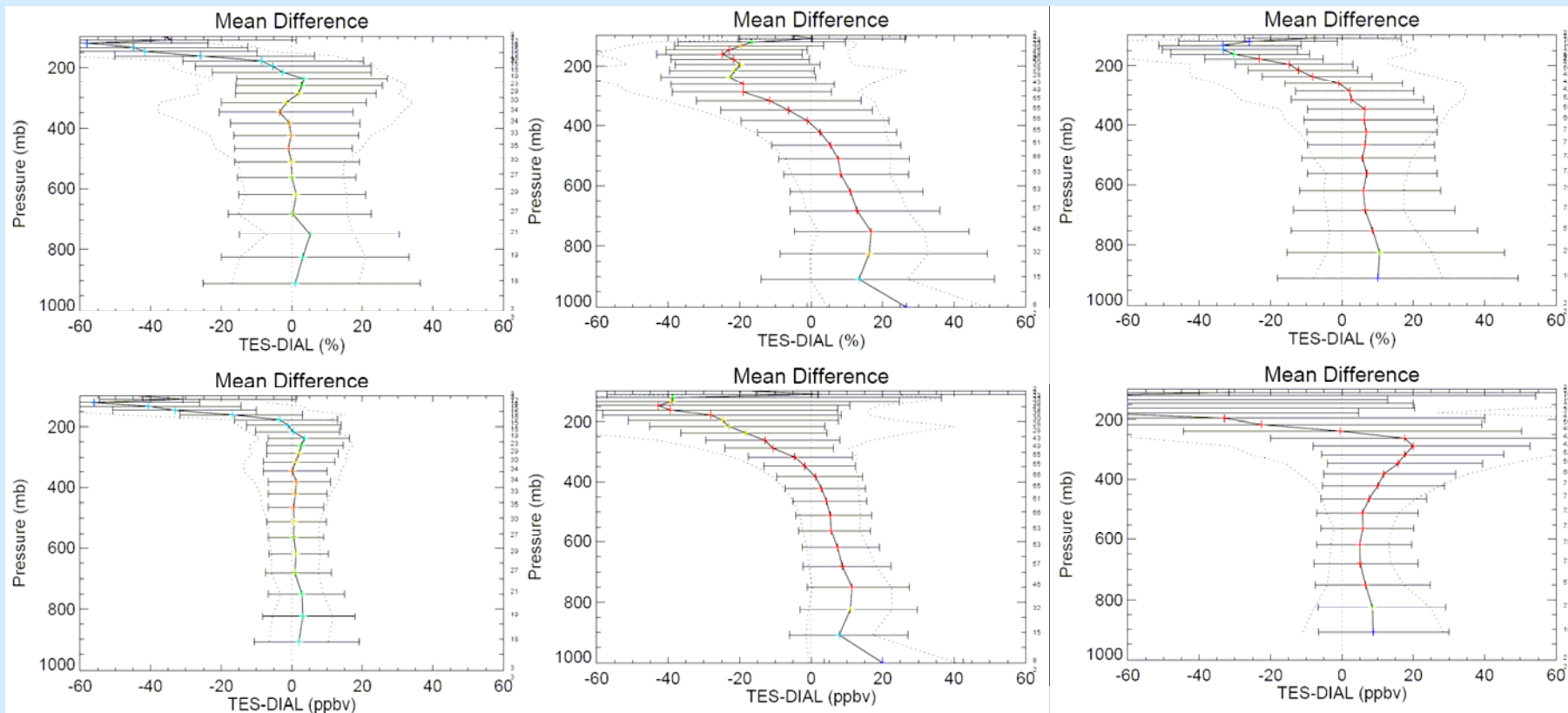
- Mean positive bias of less than 10% in the lower and mid-troposphere.
- Bias is negative in the upper troposphere and increases to up to 30%.
- Larger differences observed on individual flights, this could be due to temporal differences in collocation of observations

Results

Houston
(44 Profiles)

Hawaii
(65 Profiles)

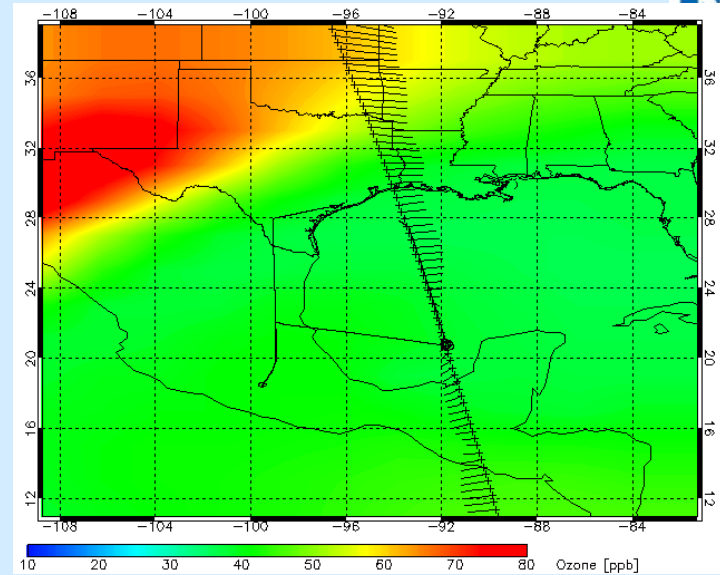
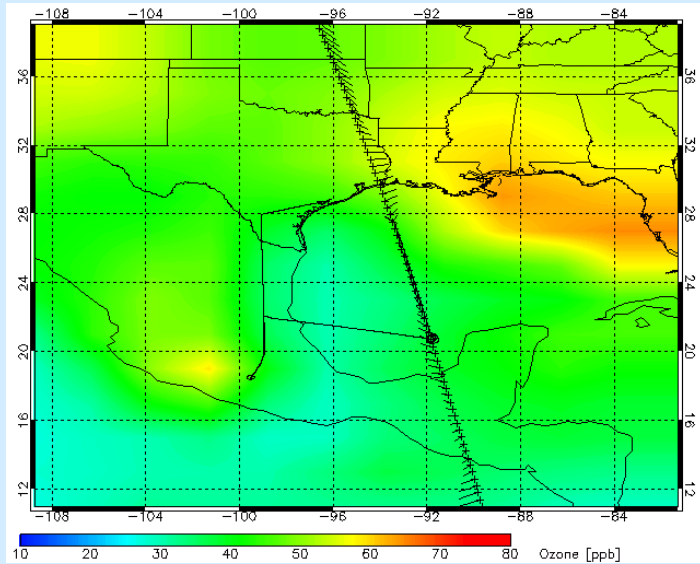
Anchorage
(80 Profiles)



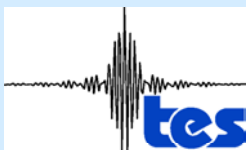
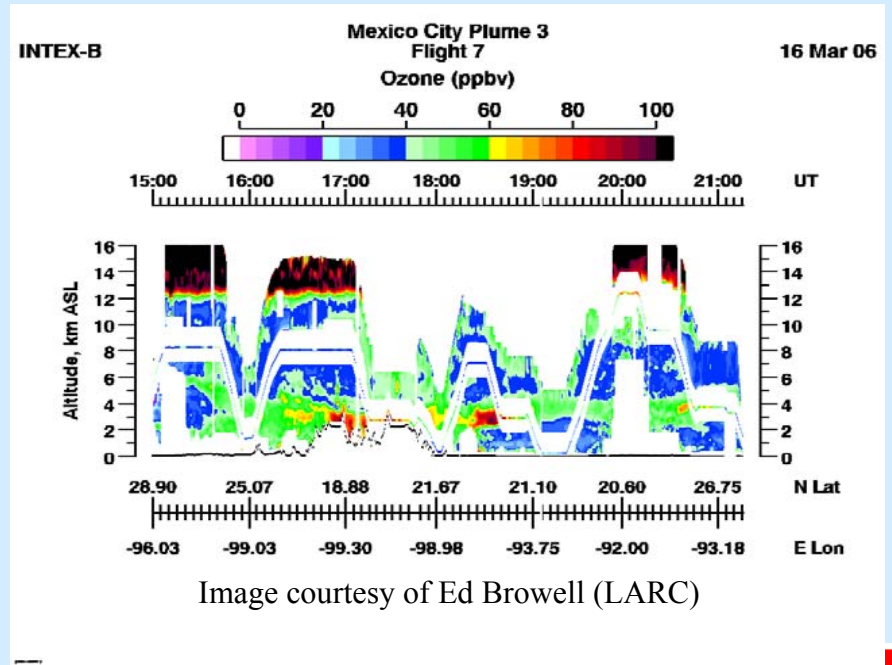
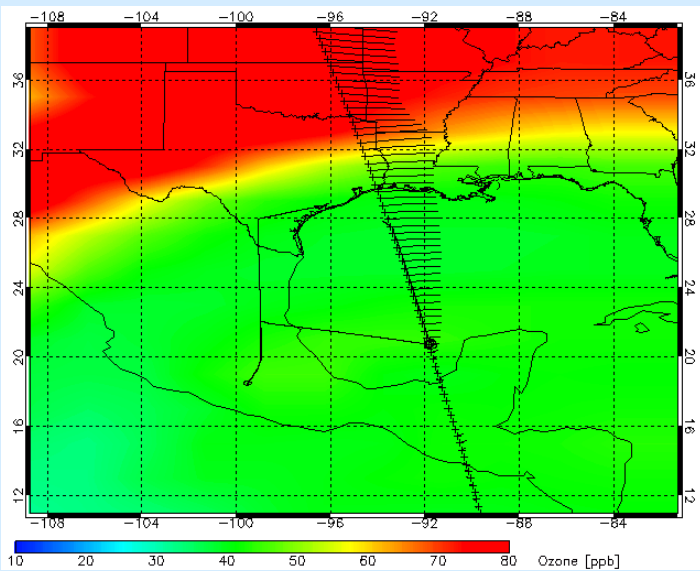
1 km

March 16th 2006 Run 3459

5 km



8 km



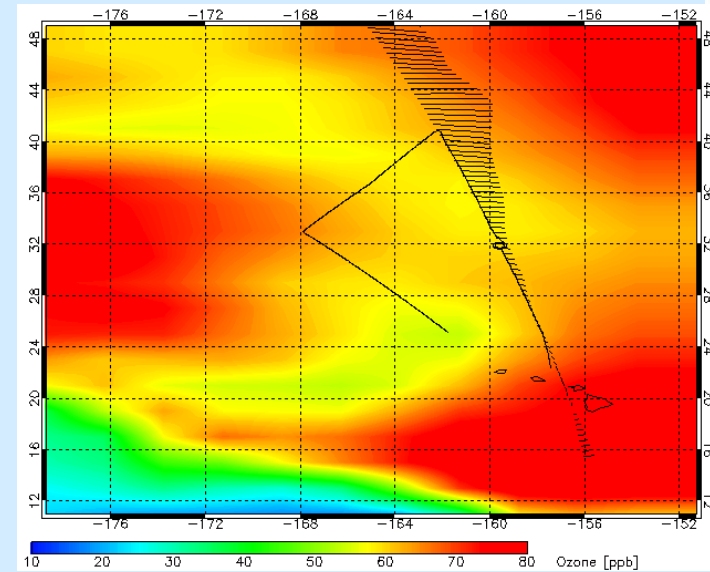
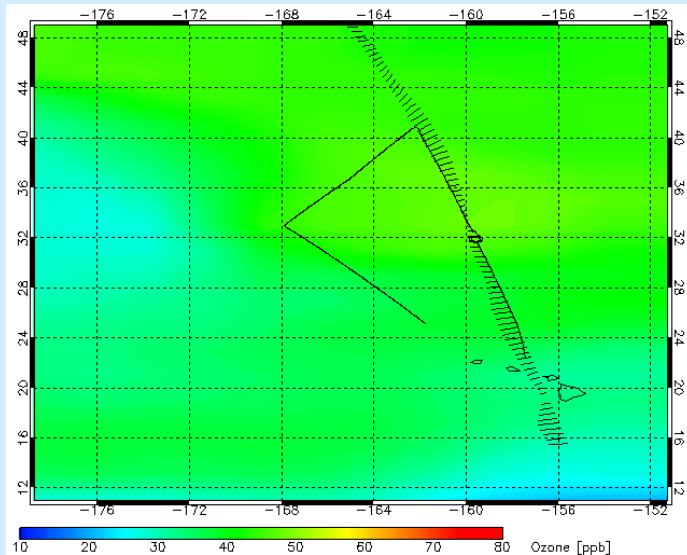
GEOS-CHEM data provided by Harvard



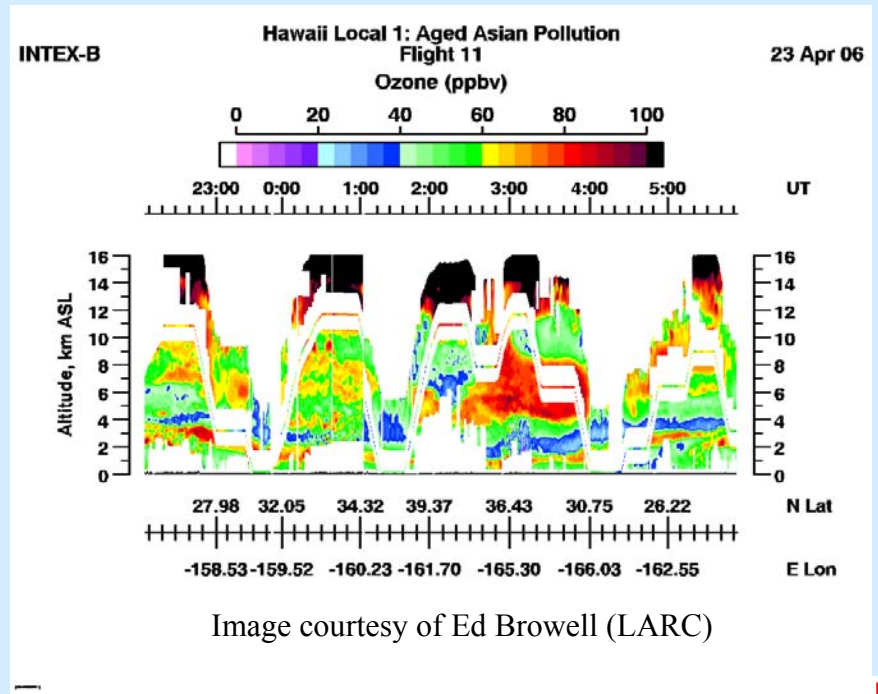
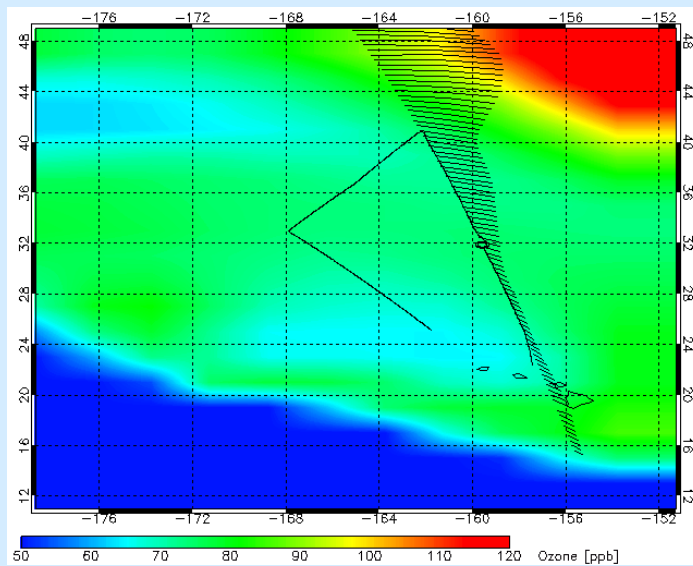
1 km

April 23rd 2006 Run 3830

5 km



8 km



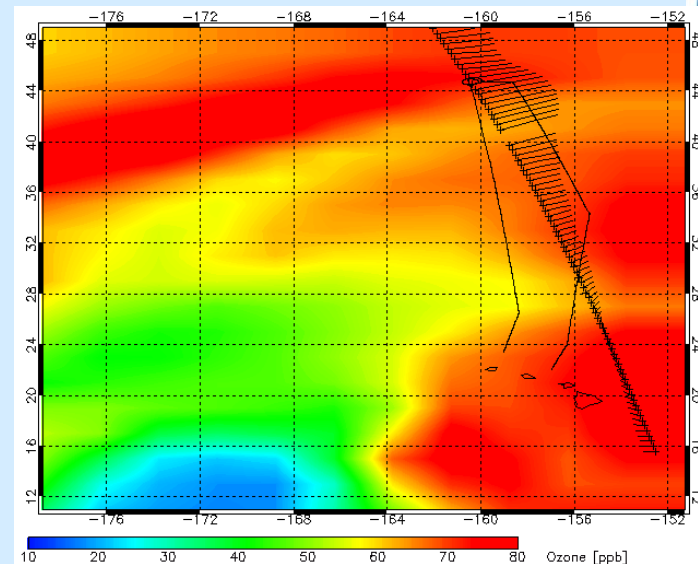
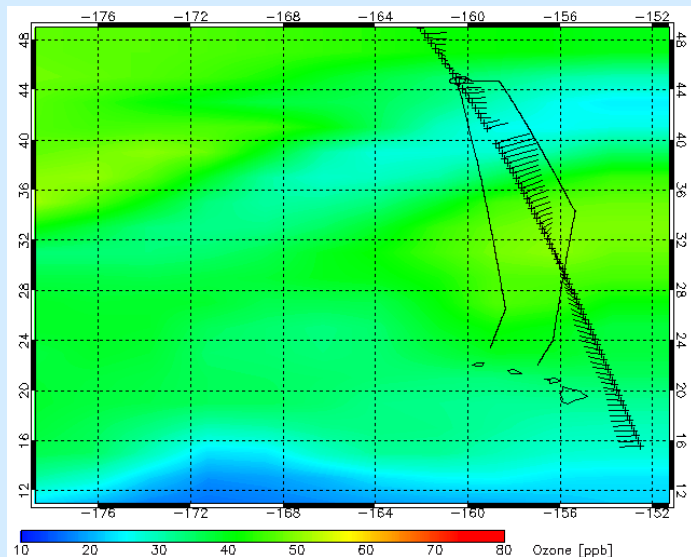
GEOS-CHEM data provided by Harvard



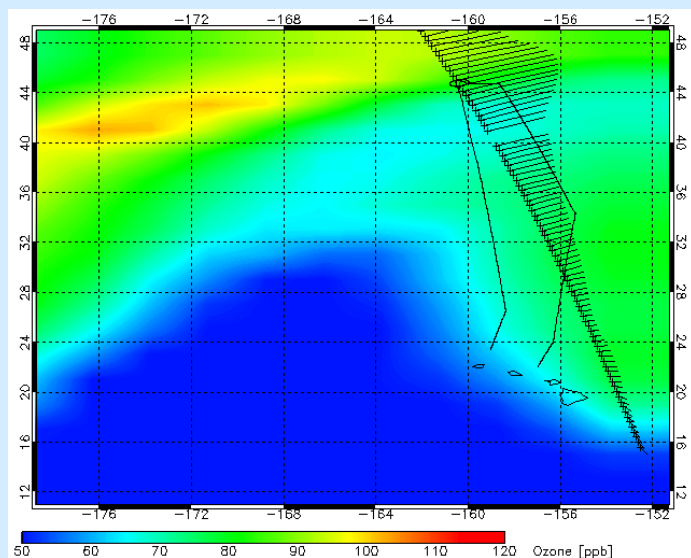
1 km

April 25th 2006 Run 3868

5 km



8 km



INTEX-B

Hawaii Local 2: Aged & Fresh Asian / MLS / TES

Flight 12

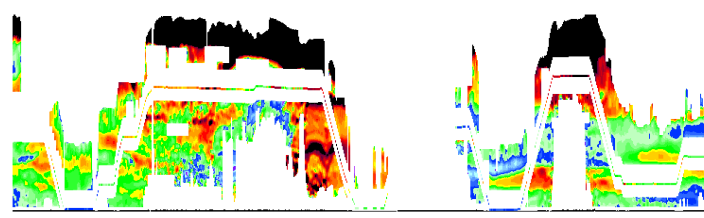
25 Apr 06

Ozone (ppbv)

0 20 40 60 80 100

20:00 22:00 23:00 0:00 1:00 2:00 3:00 4:00 UT

Altitude, km ASL

16
14
12
10
8
6
4
2
016
14
12
10
8
6
4
2
0

22.07 35.42 42.53 44.62 40.35 34.87 28.58 22.92 N Lat

-156.97 -155.68 -157.88 -160.15 -159.85 -159.22 -158.57 -159.13 E Lon

Image courtesy of Ed Browell (LARC)

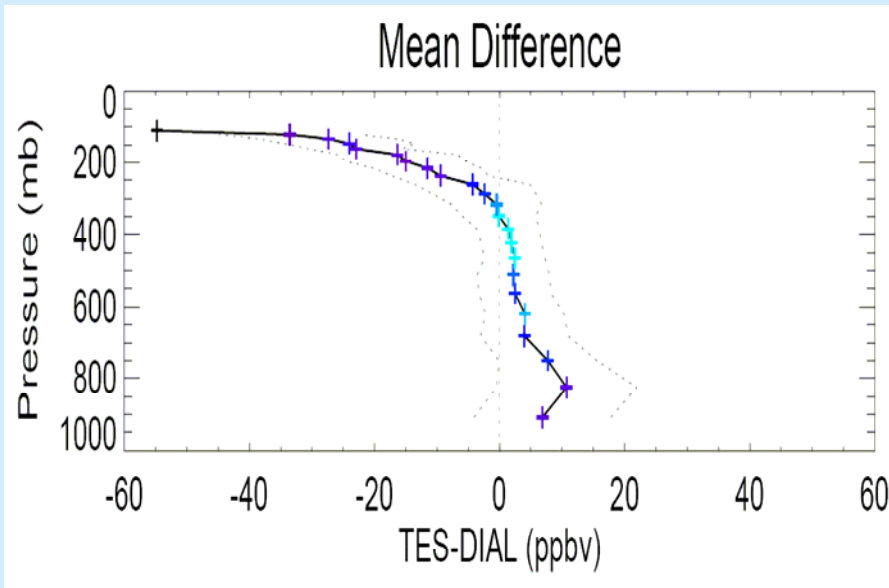


GEOS-CHEM data provided by Harvard

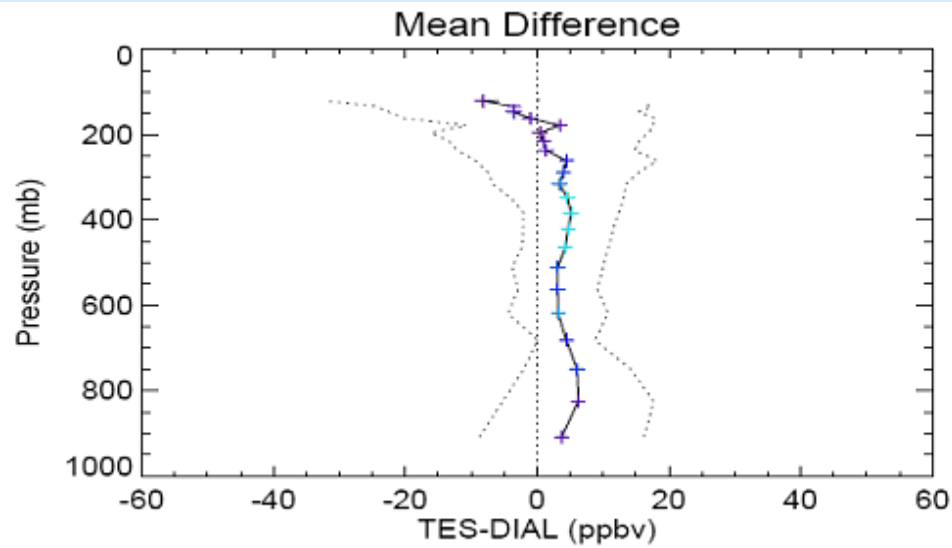




Version 2



Version 3



Conclusions



- On average TES exhibits a small positive bias in the middle and lower troposphere of 8% and a negative bias of up to 30% in the upper troposphere.
- Some of the differences could be due to the temporal mismatch of the measurements.
- Updated CO₂ micro-windows/spectroscopy improves comparisons.

